Argonne NATIONAL LABORATORY

… for a brighter future

Large Area Photodetector Development

Collaboration Meeting:

Organization & Milestones

Bob Wagner, Project Physicist

Collaboration Meeting, 15-16 Oct 2009

U.S. Department of Energy

UChicago ▶ Argonne LLC

Office of Science
U.S. DEPARTMENT OF ENERGY

A U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC

Meeting Purpose and Organization

- **Purpose:**
  - Get to know one another
  - Overview of the Project
  - Discuss challenges, plans, problems, great ideas,...
  - Plan our activity for the year

- **Organization:**
  - Please upload your presentation before your talk time
    - *Remote participants can follow along*
    - *This will archive our talks for later review*
  - Sign up for dinner if you haven't already. Can't guarantee a place now, but we'll try
  - Emphasis is on discussion. Feel free to ask questions, make comments during talks. Speakers: **Please stay on time or end early so we can have discussion**

We have approval, funding started ~7 Aug 2009,
DOE Site Visit gave good marks to work so far

Now we have to deliver!

Milestones: Office of High Energy Physics

ATTACHMENT A – CONTRACTOR RECOVERY ACT PERFORMANCE REQUIREMENTS
Advanced Technology R&D augmentation (2005170) - ANL
KA/CH12/9/ARRA-1, Rev 00

Section A: Contractor Recovery Act Schedule or Milestone Requirements	
Identify and characterize Photo-electron Emission (PE) properties of materials for photocathode development.	June 30, 2010
Demonstration of amplification with gain ≥ 300 with an atomic layer deposition (ADL)-functionalized micro-channel plate.	June 30, 2010
Achieve a differential time resolution < 10 picoseconds and a space resolution ≤ 1 mm in vacuum with a 50-ohm transmission-line anode suitable for multi-photoelectron high-precision applications.	June 30, 2010
Section B: Contractor Recovery Act Performance Outcomes and Measures	
Upgrade existing collaboration vacuum-transfer facilities to match the 8"- square module assembly.	January 31, 2010
A design, including costing and interfacing with vendors of production sealed-glass tubes, for a vacuum-transfer/assembly facility for the 8"- square module assembly.	June 30, 2010
Design a prototype 2 channel ASIC with sampling rate ≥ 20 gigasamples per second, analog bandwidth ≥ 1.5 gigahertz, and a capacitor-sampling-chain and timing-generator blocks.	June 30, 2010
Demonstration of an operational 8"- square photocathode.	June 30, 2010
Demonstration of the vacuum seal of the 8"- square window to the body.	June 30, 2010
Section C: Contractor Recovery Act Deliverables	
Summary report on progress during the year, including chapters on the individual technical achievements and knowledge gained.	June 30, 2010

Milestones: from proposal

9 Milestones

9.1 Year 1

1. **Photo-cathode Group** *Siegmund,Attenkofer,Insepov,Pellin,Yusof*
   (a) Demonstrate a quantum efficiency ≥ 25 % with a bialkali photo-cathode on a solid glass plate, with acceptable dark current;
   (b) Produce a $8'' \times 8''$ conventional photo-cathode with photo-cathode quantum efficiency. ≥ 25 %.
   (c) Screen and test flat and morphology-based negative-electron-affinity materials and compare to simulation.

2. **Glass Substrate Group** *Tremsin,Frisch,Siegmund,Hau,Pellin,Sullivan*
   (a) Develop and characterize 32.8mm glass substrates with 10-40 micron pores diameters L/D of 40, a bias angle of 8 degrees, and an open area ratio $\geq 80\%$ suitable for an MCP;
   (b) Acquire and test $8'' \times 8''$ plates;
   (c) Evaluate the process economics.

3. **Advanced Substrate Group** *Wang,Routkevitch,Pellin*
   (a) Achieve straight pores in AAO with diameter ≥ 0.7 microns (no-funnel option), 40 <L/D< 100, and open-area ratio ≥ 60 %;
   (b) Demonstrate the feasibility of making AAO funnels suitable for photo-cathode deposition;
   (c) Produce blanks of 32.8mm AAO plate for tests and MCP development.
   (d) Evaluate the process economics.

4. **Atomic Layer Deposition Group** *Elam,Insepov,Sullivan,Libera,Wang*
   (a) Systematically characterize the leading ALD materials for Photo-emission and Secondary Electron Emission (SEE);
   (b) Demonstrate gain > 1000, non-uniformity to $< 25\%$ with ALD on a 32.8mm glass capillary substrate MCP, with acceptable dark current;

5. **Testing Group** *Adams,Veryovkin,Attenkofer,Genat,May,Nishimura,Ramberg, Ronzhin, Va'vra, Varner,Wetstein,Zinovev*
   (a) Set up test protocols for the various test facilities and make appropriate modifications to accomodate up to $8'' \times 8''$ plates.
   (b) With the Simulation Group, set up data-base for systematic codification of test results.
   (c) Expeditiously test the functionalized development units from the ALD and Photo-cathode Groups

6. **Simulation Group** *Ivanov,Beaulieu,Abrams,Genat,Insepov,Roberts,Tremsin,Tang*
   (a) With the Test Group, set up data-base for systematic codification of test results.
   (b) Systematically compile existing data on materials and define the needed measurements for characterization by the Emissive Materials Group;
   (c) Complete the MCP simulation code including space charge;
   (d) Validate the simulation with commercial tubes;
   (e) Complete a first-generation glass-substrate-based MCP-PMT simulation;
   (f) Complete a first-generation AAO/ALD-based MCP-PMT simulation;
   (g) Optimize funnel and pore shapes for an MCP-PMT with opaque photo-cathode.

7. **Mechanical Assembly Group** *Stanek,Northrop,Anderson,Forbush,Genat,Ronzhin,Sellberg,Siegmund, Tremsin,Wetstein,Zhao*
   (a) Identify candidate materials, vendors, and construction methods for the $8'' \times 8''$ and $4' \times 2'$ modules;
   (b) Complete an initial mechanical/electrical design for proto-type glass and ceramic $8'' \times 8''$ modules, and construct mechanical proto-types (no photo-cathode yet);
   (c) Measure the vacuum, residual gases, out-gassing rates, and surface chemistry of proto-type modules;
   (d) Assemble a complete Development(32.8mm) AAO/ALD or glass capillary MCP-PMT with conventional photo-cathode for testing.
   (e) Evaluate the process economics.

8. **Electronics Group** *Varner,Genat,Anderson,Bogdan,Drake,Frisch,Heintz,Kennedy, Nishimura,Rosen,Ruckman,Tang*
   (a) Construct and test a $8'' \times 8''$ proto-type transmission-line anode (e.g. velocity, time resolution, cross-talk, attenuation);
   (b) Construct a first-generation clock distribution system;
   (c) Construct a first-generation DAQ system;
   (d) Construct a first-generation anode PC card with existing sampling chips [23, 22];
   (e) Submit a first IBM-8RF chip with timing control, sampling capacitor chain, and ADC blocks.

9. **Integration Group** *Drake,Genat,Anderson,Byrum,Frisch,Ronzhin,Sanchez,Siegmund,Tremsin,Wetstein*
   (a) Install the first-generation clock distribution system and DAQ computer in the integration area;
   (b) Integrate the first-generation DAQ and MCP with first-generation front-end card with existing sampling chips;
   (c) Integrate the individual tests into a user-accessible system suite.

10. **Management Group** *Frisch,Siegmund,Byrum,Pellin,Weerts*
    (a) Identify the senior staff member at Argonne responsible for tracking costs, schedules, responsibilities, and reviews;
    (b) Identify co-leaders for each of the groups.
    (c) Establish the project in the appropriate project manager software;
    (d) Establish preliminary major decision points for photo-cathode, geometry, substrate, module size, mechanical assembly, and cost;
    (e) Select internal review committees and schedule reviews;
    (f) Survey and clarify IP and future production relationships with industry;
    (g) Evaluate the process economics for each major component.

So What's My Job Here

- Work with Henry, Karen, and Dean on all the items below to assure our success
- Keep the focus on milestones and overall development of a functional 8"×8" detector that meets our design goals: QE, gain, uniformity, time resolution, cost.
- Attempt to have a grasp of the current status of the grand picture
  - Where we are succeeding and progressing well
  - Where we are having problems, what is not working
  - Coordinate the work in each area so we progress in tandem
- Make sure you have what you need: materials, equipment, contracts
  - Be aware that I can ask, beg, cajole,...
  - I cannot set prices, negotiate terms, make awards, change orders w/o approval
  - Administration at Argonne may seem (or actually be) aggravating, slow, bureaucratic, but most people here are friendly, helpful and do their job well.
    - *Pay in cash and it will be easier when we need credit*